Propagation of cosmic rays in the Galaxy

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Studies and discoveries in cosmic-ray physics and generally in Astrophysics provide a fertile ground for research in many areas of Particle Physics and Cosmology, such as the search for dark matter, antimatter, new particles, and exotic physics, studies of the nucleosynthesis, origin of Galactic and extragalactic gamma-ray diffuse emission, formation of the large scale structure of the universe etc. In several years new missions are planned for cosmic-ray experiments, which will tremendously increase the quality and accuracy of cosmic-ray data. On the other hand, direct measurements of cosmic rays are possible in only one location on the outskirts of the Milky Way and present only a snapshot of very dynamic processes. It has been recently realized that direct information about the fluxes and spectra of cosmic rays in distant locations is provided by the Galactic diffuse gamma-rays, therefore, complementing the local cosmic-ray studies. A wealth of information is also contained in the isotopic abundances of cosmic rays, therefore, accurate evaluation of the isotopic production cross sections is of primary importance for Astrophysics of cosmic rays, studies of the galactic chemical evolution, and Cosmology. In this talk, we will show new results obtained with GALPROP, the most advanced numerical model for cosmic-ray propagation, which includes in a self-consistent way all cosmic-ray species (stable and long-lived radioactive isotopes from H to Ni, antiprotons, positrons and electrons, gamma rays and synchrotron radiation), and all relevant processes and reactions.

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